IBP

HDM99

User Guide

Preface

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Rev 1 August 2002	Temperature Coefficient for B.Braun now 2.10%/°C
Rev 2 September 2002	Temperature Coefficient for Gambro now 2,07%/°C
	Conformity Declaration in accordance with Medical Product Law
	Flow Measuring extended
	Window Entrance Test added
	Specification: Temp. Accuracy 25 … 40°C $\pm$ 0.07 °C otherwise $\pm$ 0.1 °C

This user guide is only valid for software releases 3.6x (x = 0..9)

Safety Instructions

For your own safety, and the safety of your patients, follow these important safety instructions as well as other safety instructions noted throughout this User Guide.

- **Please read the User Guide in its entirety before using the HDM99.**

- **Keep away the device from unauthorized persons.**

- **Never use the HDM99 on a dialysis machine to which a patient is connected.**

- **Never use the HDM99 on a dialysis machine with a connected battery charger.**

- **Never use the HDM99 in place of the hemodialysis machine's primary sensors.**

- **Operate the instrument only in a dry environment, and do not touch it with damp hands.**

- **Ensure that no fluids intrude into the interior of the device or into the sockets at the front.**

- **Apply a clean Transducer Protector to the nozzle for the pressure measurement.**

- **Verify accurate function of the meter before taking measurements or whenever inaccurate readings are suspected.**

- **Avoid a discharge of static electricity over the sockets. It could lead to the destruction of your instrument. Before touching the sockets and lines that are connected with them, dissipate any static electric charge that may be present in your body.**

- **Only calibrate the HDM99 if you have understood the consequences to their full extent. Use only the recommended standards later in this manual.**

- **Do not use abrasive cleaning agents and/or full strength bleach or acid to clean HDM99 or the electrodes as this will cause damages.**

- **Voltages above 40 V can be dangerous. Take extreme care while working with higher voltages.**

- **To avoid electrical shocks, and/or damage to your measuring system, do not apply excess voltages above 40 V to the instrument.**

- **Do not open the device.**

- **To avoid current loops use the RS232-Interface only with notebooks which are not connected with the battery charger.**

- **Federal law restricts the use of this device to sale by or on the order of a physician.**

Introduction

The HDM99 is a self-contained hemodialysis test instrument designed for the measurement of

Conductivity
Temperature
Pressure
pH
Flow
Voltage
Frequency
Period time
Pulses..

This innovative device has been designed to be user-friendly, reliable, and rugged enough for the demanding needs of hemodialysis technicians. In addition, the HDM99 may also be used for environmental measurement and other non-medical applications.

The measured values are displayed numerically on the instrument's large screen. The instrument also may be connected to a computer, and using the supplied software, displayed, stored and analyzed.

Please take a few moments upon initial receipt of your shipment to ensure that all the items listed below have been included. In the event of a discrepancy, contact your supplier immediately. Be sure to read this User Guide in its entirety before first using the product.

Applications for use

The HDM99 may be used by hemodialysis personnel to test the conductivity, temperature, pressure, pH and flow of the dialysate solution used with hemodialysis delivering systems. The HDM99 may also be used to test the conductivity/temperature and pH of acid and sodium bicarbonate dialysate concentrates and water used in hemodialysis applications. The HDM99 may also be used to test the voltage and alternating signals in hemodialysis delivering systems.

EC Declaration of Conformity

according to the Council Directive 93/42/EEC
concerning medical devices

We

IBP Instruments GmbH
Sutelstraße 7A
30659 Hannover

declare under our sole responsibility that the product:

HDM99,   Art.-Nr.: 31.0006.

meet the provisions of the Council Directive 93/42/EEC concerning medical devices which apply to them.

CE – certified by : Medcert GmbH Hamburg, Germany   Nr.: 0482

Date of issue: 09.08.02

Authorized person :   Dipl. Ing. Werner Pfingstmann (Managing director)

Delivery Content

Pos.		Standard	Option
1	HDM99	x	
2	Conductivity/Temperature Probe (CTP)	x	
3	Flow Through Adapter for CTP	x	
4	Battery Charger with country specific adapter	x	
5	Tube inc. Male Connector for Pressure Measurement	x	
6	13,63 or 14.00 mS/cm Conductivity Standard Solution	x	
7	User Manual	x	
8	Interface Lead Voltage	x	
9	Interface Lead Frequency/Period Time/Pulses	x	
10	Test prod	x	
11	Case		x
12	Flow Probe		x
13	pH Probe with Reference Solution		x
14	HDMView Software and RS232 Interface Cable		x

Warranty

IBP Instruments GmbH warrants that it will repair or replace, at its option, any defective or malfunctioning part without charge for the terms listed below. Parts used for repair or replacement are warranted for the remaining warranty period only.

The user must deliver, at its own expense, the product to IBP Instruments Inc., USA, from any country in America or IBP Instruments GmbH, Germany from all other countries.

Parts	Warranty Terms*	Conditions
HDM99	60 months	Annual calibration through IBP**
Conductivity/Temperature Probe	24 months	Annual calibration through IBP**
HDM99	36 months	No
Conductivity/Temperature Probe	12 months	No

     *   from date original purchase of original purchaser
    ** Calibration service must be performed by IBP Instruments every year
       (maximal plus 2 months of the first calibration) without interruption

The warranty does not cover:
- Disposable parts as battery or pH electrode
- Annually calibration
- Cell cleaning
- Defects caused by:
  1. Modification, alteration, repair or service of the product by anyone other than IBP Instruments or an authorized service center
  2. misuse due to negligence or accident
  3. operation or maintenance of the product in a manner contrary to IBP instructions

Any express warranty not provided herein, and any remedy for breach of contract that but for this provision might arise by implication or operation of law, is hereby excluded and disclaimed. The implied warranties of merchantability and of fitness for any particular purpose are expressly limited to the terms mentioned above. Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you.

Under no circumstances shall IBP Instruments GmbH be liable to the original purchaser or to any other person for any special or consequential damages, whether arising out of breach of warranty, breach of contract, or otherwise. Some states do not allow the exclusion or limitation of special or consequential damages, so the above exclusion or limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

For further warranty information, contact IBP Instruments GmbH.

Product Overview

Voltage Connector

Flow/Alternating Signal Connector

Pressure Inlet

pH Connector

Conductivity/Temperature Connector
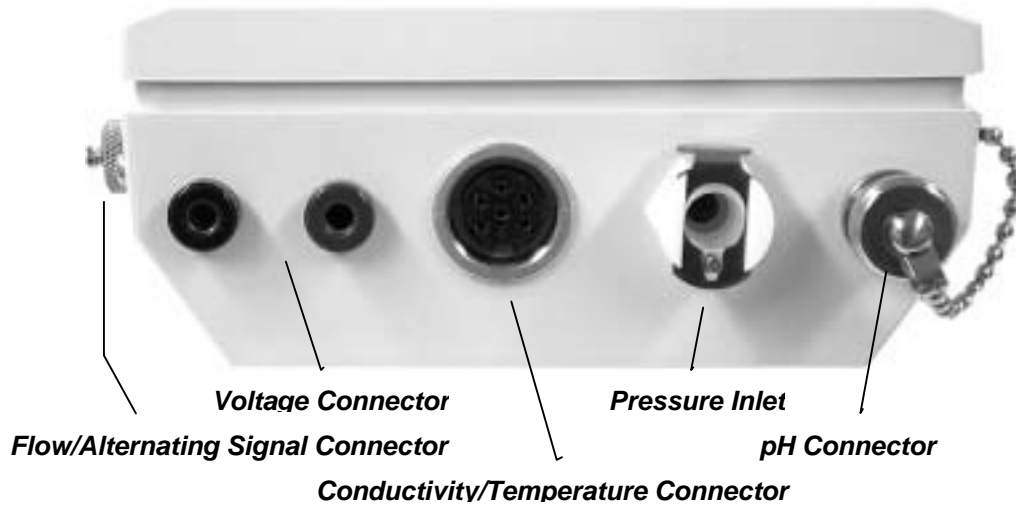
Measuring Channels

Only use accessories provided with the HDM99. Use of other devices may damage the instrument and will void the warranty.

Conductivity/Temperature Transducer

The Conductivity/Temperature probe is a quadropole design for greater accuracy and longevity than other designs. Take care to properly align the pins in the connector when attaching the transducer.

Pressure

To avoid damage or inaccurate measurement, ensure that no fluids enter the instrument. We recommend the use of a Transducer Protector for this purpose.

pH

The input connector is designed exclusively for pH electrodes. Use of other devices may destroy the instrument.

Flow

The connection is to be found at the right side of the device.
(8 pol. connector)

Frequency, Periodicity and Events

The connection on the right side of the device is also used for the measuring of the flow. The incoming voltage range is +5...+24 V. The form of the signal should be of a rectangular form and has to be positive**.**

Voltage

The sockets are intended only for AC and DC voltages up to ± 40 V. They are protected up to ± 80 V.

Battery Charger

The HDM99 is equipped with an internal NiMH battery for extended run times when not connected to the external charger. The charger provides a 12V/500mA charge to the battery. A message appears on the display when the battery requires charging. For further details, consult the Maintenance section of this User Guide.

Use of the Flow Through Adapter

The Conductivity/Temperature Transducer may be used in two ways.

In the **Flow-Through Mode** *(illustrated at left)* the user may measure pressure, temperature and conductivity with the included Flow Through Adapter. The preferred position of the Hansen connector is vertical, the axial supply is show at the bottom of the illustration. In the Flow-Through Mode the axial supply is used as input and the radial supply as output. The pressure probe in the HDM99 is fastened to the radial connection above the input. Before any measurements you must shake the connector to assure that any air within the system escapes.

In the **Dip Mode** temperature and conductivity can be measured. For this mode open the screw cap at the upper end of the connector and extract the combined electrode. You must not remove the tube covering the probe carrier. Dip the electrode into the media up to a level above the holes in the covering tube. By moving the electrode you assure that the trapped air can escape and the temperature is well balanced.

NOTE: Do not touch the surface of the electrode with your fingers.

Switching on the unit

The unit is switched on and off with the keys marked **I** for on and **O** for off. The unit also switches itself off automatically when the *switch-off time* after the last key activation is over or the battery is fully discharged.

Main Menu

After switching on the device you receive an information menu for approx. two seconds. After that the system goes back to the last setting. In some cases you will receive the following main menu.
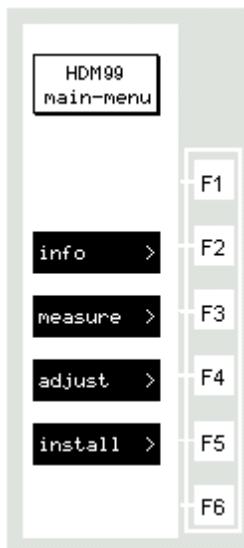
HDM99 **main-menu**	
	Activation of the function keys leads to
F1	
info > F2	display of the info-menu
measure > F3	display of the measuring menu
adjust > F4	display of the calibration menu
install > F5	display of the installation menu
F6	

Info

From the root menu via *info* you receive the following information:
There are device specific data like product name, software version and version date as well as
the serial number of your HDM99.

Installation

HDM99 main-menu	HDM99 -install-	install language	Install -Sprache-	install switch-off

		language↑	Sprache ↑	off-time ↑
info >	language >	Deutsch **English**	**Deutsch** English	10min **20min** 30min 1h 2h 4h --
measure >	switch-off-time >			
adjust >	adjust reset >	language↓	Sprache ↓	off-time ↓
install >		ok >	ok >	ok >
	menu >	cancel >	Abbruch >	cancel >
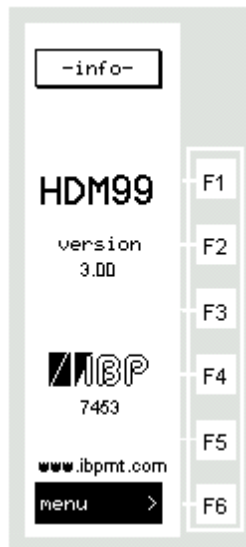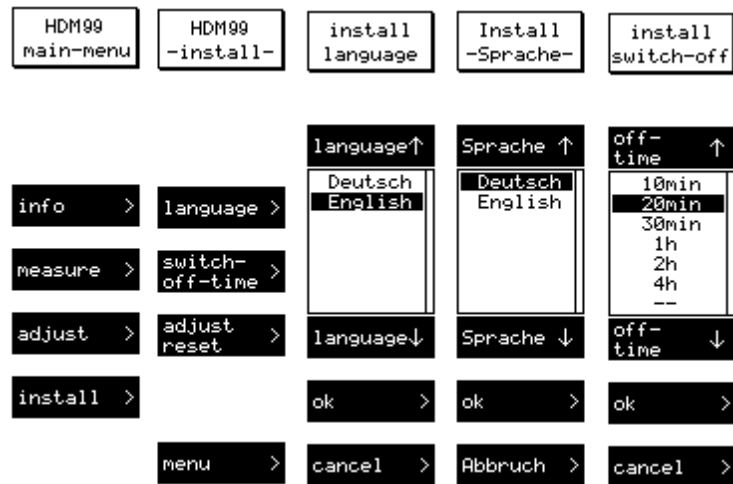
Language

By pressing the function key beside the menu point *language* you will reach the language choice. With the keys beside the arrows you can select the desired language for your work with HDM99. The selection is shown inverted. With activation of *ok* you will return to the installation menu.
After altering the language the entire menu leadership and display appears in the chosen *language*.

Switch-off time

The *switch-off time* is the time after the last key activation. At the end of this time the device switches off automatically.
The activation of the function *switch-off* leads to a selection of times which can be selected with the arrow-keys. The chosen time is shown inverted and taken over with *ok* as new switch-off time in the installation menu. If >--< is chosen, the automatic power shutoff is cleared, the device remains active until it is switched off manually with the key >*OFF*<.

Adjust-reset

With the adjust-reset the calibration values for all measuring channels can be set to basic values. These basic values are the calibration values of the company conducted calibration. Operate the function key beside this menu point. You will have to enter a code via the numeric keyboard. This code is **1704**. When you confirm your input with >enter< you will receive the following images:
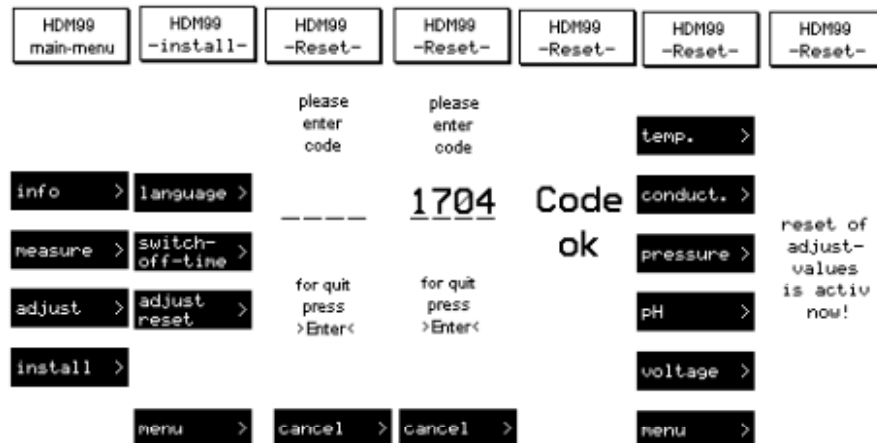
With the function keys beside the individual measuring channels you can decide on which calibration values this function should be applied. The calibration values will be reset to basic values.

If for individual parameters the function *adjust reset* was used, then a new verification is necessary for these parameter.

The reset of the flow measurement only resets the parameters of the flow sensors 1....7. The possibly existing calibration values of own sensors remain unchanged.

System Error Message

When the HDM99 is switched on, an internal check is initiated. If the check shows no errors the HDM99 is started using the menu which was last in use. If the check reveals an error, following error message (window) is displayed:

```
Systemtest


#1 MEM  OK
#2 ADC ERR
#3 ADJ  OK
#4 SYS  OK
MC :      3
ECT:     10




   Please
   call for
   Support!




cancel    >
```
Example: AD-Converter Error

An" OK" error display shows that the internal test routine has been completed with no errors found. An "ERR" in the display shows that a problem has occurred during the check. When this error report is displayed, please contact IBP.

#1 MEM – Memory Error

This error is displayed when an internal memory check shows that a problem has occurred. The unit is need of repair.

#2 ADC - AD-Converter Error

This error display is shown when a defect is fount in the Analog/Digital-Converter. The unit is need of repair.

#3 ADJ – Cecksum Error

The calibration values are saved to memory together with an internal check sum.
This check sum is used each time the system is started to verify that all memory data remains unchanged.
The aforementioned text is displayed when an error occurs during system start-up; the unit cannot function while the error is displayed and a renewed calibration is mandatory.

#4 SYS - Watchdog Error

This message is displayed when the unit is restarted after a system crash. To delete the message, switch the unit off and then on again. If this error occurs at regular intervals, please contact IBP for   support.

MC, ECT – Additional Information

The entry on the display following the MC and ECT are IBP error messages facilitating problem analysis. When contacting IBP to report an error, please report the messages describing the system error.

Measurement

From the main menu over *measuring* you will receive the following menu:
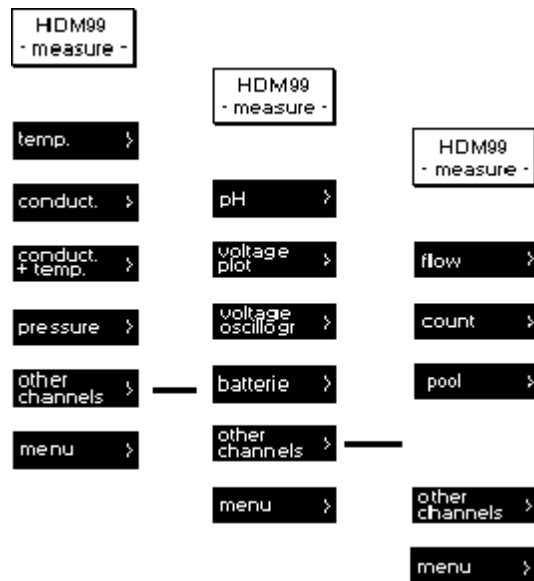
Examples for measurement displays
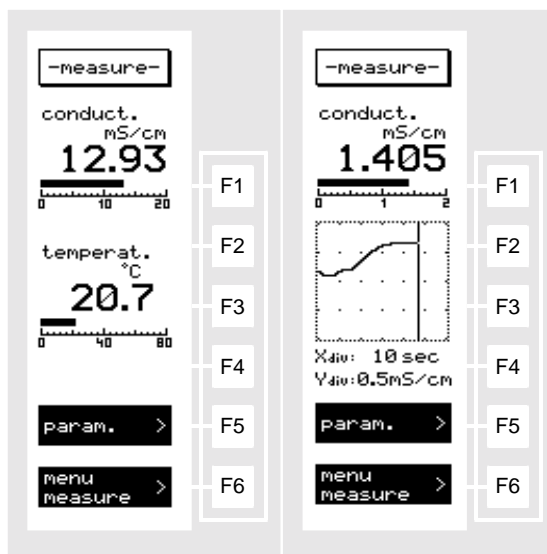
Activation of the function keys F5 leads to the menu for the parameter setting
F6 leads back to the main menu

The handling of all menus corresponds to the already explained operating instructions. The individual menus and sub-menus are presented and explained below.

Temperature measurement

```
┌─────────┐   ┌─────────┐   ┌─────────┐
│-measure-│   │-measure-│   │parameter│
└─────────┘   └─────────┘   │ -temp-  │
                            └─────────┘
 temperat.     temperat.
    °C            °C
 No Temp-       29.8        ┌─────────┐
  Sensor        ▃▃▃        │time-   >│
                            │range    │
 0    40   80  0    40   80 └─────────┘

 ┌───────┐   ┌───────┐     ┌─────────┐
 │. . . .│   │. . . .│     │y-      >│
 │. . . .│   │. . . .│     │range    │
 │. . . .│   │  ___. │     └─────────┘
 │. . . .│   │_/   . │
 └───────┘   └───────┘        ┌─────────┐  ┌─────────┐
 Xdiv: 10sec Xdiv: 10min      │parameter│  │parameter│
 Ydiv: 20°C  Ydiv: 20°C       │ -temp-  │  │ -temp-  │
                              └─────────┘  └─────────┘
 ┌─────────┐ ┌─────────┐
 │param.  >│ │param.  >│     ┌─────────┐  ┌─────────┐
 └─────────┘ └─────────┘     │time-  ↑ │  │y-     ↑ │
                             │range    │  │range    │
 ┌─────────┐ ┌─────────┐     ├─────────┤  ├─────────┤
 │menu    >│ │menu    >│ ┌─────────┐ │ 24min │  │0..100 °C│
 │measure  │ │measure  │ │measure >│ │ 30min │  │0...80 °C│
 └─────────┘ └─────────┘ └─────────┘ │ 36min │  │0...60 °C│
                                     │ 48min │  │0...40 °C│
                                     │ 1.0h  │  │20..60 °C│
                                     │ 1.5h  │  │30..50 °C│
                                     │ 2.0h  │  └─────────┘
                                     ├─────────┤  ┌─────────┐
                                     │time-  ↓ │  │y-     ↓ │
                                     │range    │  │range    │
                                     └─────────┘  └─────────┘
                                     ┌─────────┐  ┌─────────┐
                                     │ok      >│  │ok      >│
                                     └─────────┘  └─────────┘
                                     ┌─────────┐  ┌─────────┐
                                     │cancel  >│  │cancel  >│
                                     └─────────┘  └─────────┘
```

Time range

By activation of the function key *param.* you will receive a menu which allows to change the *time range*, in which the course graphic will run through horizontally once. Long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or - like in the example - further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

Conductivity measurement
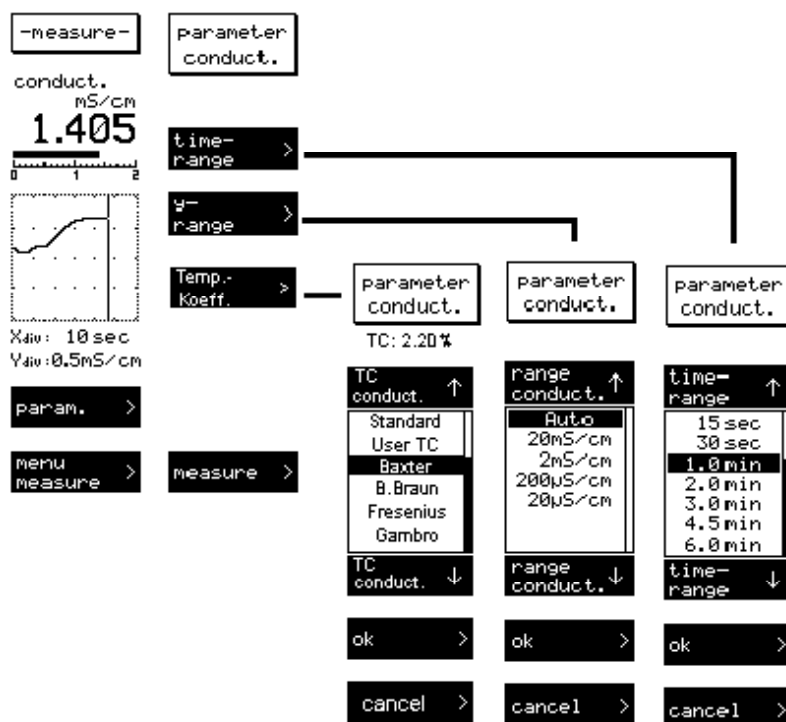
After activation of the function key *param.* you will get to the menu which allows you to change the *time range* (horizontal axis of the graph) or the *y-range* (vertical axis) and also the temperature coefficient. By activation of the function key for the range to be changed you see the selection menus.

At the *time range* long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or - like in the example -, further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

After the choice of the field *y-range* four fixed measuring ranges can be selected in the already explained way with the function keys beside the arrows. If you choose > *auto* <, the HDM99 automatically adjusts the measuring range so that an optimal graphic representation of the running measurement is assured.

With activation of the function key *ok* you arrive back in the conductivity measurement. The vertical axis of the course graphic as well as the scale length of the beam display now correspond to the measuring range you have chosen.

The temperature coefficient menu point allows many different setting possibilities. In the parameter menu for conductivity and also conductivity + temperature, it is possible to choose from a list of preset temperature coefficients of various dialysis machine manufacturers. These are listed by name.
There is also a standard value of 2.07% / °C and a user value. The user value can be changed in the usual way in the adjustment menu for conductivity. All settings are permanent until the next change. The selected setting is shown in the measurement menu.

The conductivity measurement has a range of 0 to 23.99 mS/cm, which is divided into four conductivity measuring ranges to provide highly accurate measurements. These four ranges are as follows:

<div align="center">

Conductivity Ranges

Range One	0 - 19.9 µS/cm
Range Two	0 - 199.9 µS/cm
Range Three	0 - 1999 µS/cm
Range Four	0 - 23.99 mS/cm

</div>

If the conductivity measured is outside this range, **OFL** will appear on the display.

Temperature Coefficients

Temperature Coefficients and Conductivity Measurement
This is a topic that is frequently misunderstood and often neglected in hemodialysis.

A solution's conductivity will change according to temperature. With increasing temperatures, the measured solution's conductivity will increase, too. To achieve meaningful measurement results, the conductivity value displayed is compensated to 25°C. In other words, the display is always converted to a solution temperature of 25°C. The temperature coefficient which the displayed value is compensated with is expressed as %/°C. Unfortunately however, different solutions also have different temperature coefficients. To achieve an exact display, the instrument will have to be adjusted to the temperature coefficient of the current solution. The average temperature coefficient for dialysates is 2.07 %/°C.

Listed below are the temperature coefficients used by most major hemodialysis machine manufacturers. We recommend that you doublecheck this data with documentation from your machine's manufacturer.

Machine Manufacturer	Temperature Coefficient
Baxter (European Machine)	2.20%/°C
Braun	2.10%/°C
Fresenius	2.10%/°C
Gambro European machines	2.07%/°C
Gambro Phoenix	2.07%/°C
Hospal	2.07%/°C
Nikkiso	
Bicarbonate conductivity	2.02%/°C
Total conductivity	2.05%/°C

For naturally occurring solutions, a value of 1.97 %/°C is frequently used. Many measuring devices not specially tailored to dialysis will use this value.
The calculation below shows the drastic effects of an incorrect temperature coefficient.

Example calculation for an incorrect temperature coefficient, using a dialysate with a temperature coefficient of 2.07 %/°C:

Conductivity of Solution mS/cm	Temperature of Solution °C	Instrument Temperature Coefficient %/°C	Instrument Display mS/cm	Difference in Values %
14.00	37.0	2.07	14.00	0.00
14.00	37.0	1.97	14.17	1.21

Thus, our example illustrates that the user must set the temperature coefficient correctly in order to ensure accurate measurements.

Which temperature coefficient you should use

First of all please double-check the Temperature coefficient with the machine manual.
If you have machines from one manufacturer only in your use the temperature coefficient that the dialysis machine uses for compensation.

If you have different types of dialysis machines in your unit the best solution is to use a temperature coefficient of 2.07 %/°C for **all** machines. This avoid confusion with different readings of the conductivity on different machines.

Setting the Temperature Coefficient

The HDM99 enables you to easily set different temperature coefficients. You can choose between eight fixed settings and a variable value. The fixed values are values of frequently used dialysis machines. The variable value can be set to any required value.

Pressure measurement
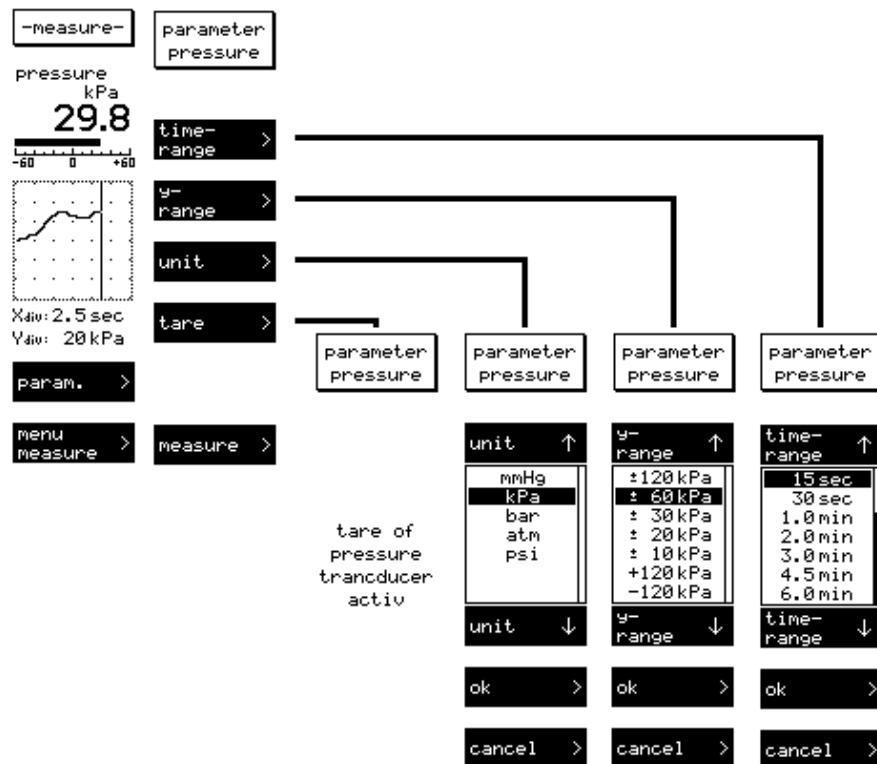
Time range

After activation of the function key *time range* you will get to a menu which allows to change the *time range* (horizontal axis of the graph).

Long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or - like in the example -, further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

Unit

The *unit* for the pressure measurement can be chosen. The values are converted when the unit is changed. A new calibration is not necessary.
The selection of the unit is done in the familiar way with the function keys beside the arrows. With *ok* you return to the pressure measurement, where now the results will be shown in the newly chosen unit.

Balancing an offset

Caused by drift of the pressure probe, the pressure display may sway slightly around zero. With the function *tare* the display is set to zero. You must not apply pressure to the HDM99 during this function. This is assured when the pressure tube is not connected. Then the environmental pressure represents zero.
The choice of the function key *tare* results in the reset of the display to zero and the automatic return to the pressure measurement.

Further possible measurements

With the option *other channels* you can shift to a second measuring menu where you have the choice between two different modes of voltage measurement: the test for pH-value and the control of the charging state of the accumulators.
If you would like to return to the first measuring menu with conductivity, temperature and pressure measurement choose *other channels* again.
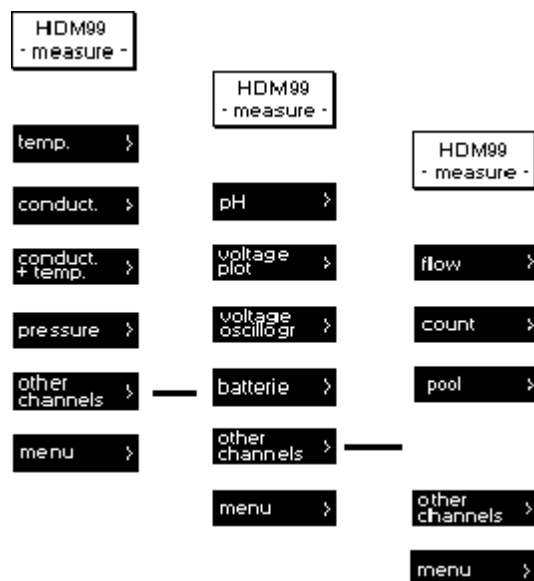
pH Measurement

Time range

By activation of the function key *param.* you will receive a menu which allows to change the *time range* in which the course graphic will run through horizontally once. Long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or -like in the example- further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

Temperature compensation pH-measurement

For the temperature calibration of the pH-measurement the device offers two possibilities. The solution temperature can be measured via the conductivity and temperature electrode, or entered by hand. The chosen kind of the calibration is check-marked in the menu point *measure t-comp* or *enter t-comp*. If you choose *measure t-comp.* no further input is necessary. The temperature will be measured via the measuring cell.
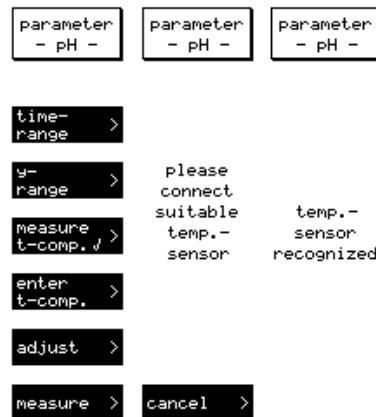
By choice of *enter t-comp.* you will be asked to enter the solution temperature via the numeric keyboard. After confirmation with *>ENTER<* you will return to the menu for the parameter setting

Fundamental information about pH measurement

For measuring pH, a combined electrode is used. Combination pH electrodes are combinations of one reference electrode and one measuring electrode in a glass tube. The pH value in the dialysate is measured by an unbreakable pH-electrode. The glass body is protected with a plastic coat and due to the jelly-electrolyte-filling, it is maintenance-free. This electrode`s diaphragm must be stored in 3 mol/l KCl-solution. The protective cap must be refilled every three to four weeks to prevent the electrode from drying out. Before use the electrode must be checked for exterior damage and crushed glass. Crusts caused by leaking electrolyte can be removed easily by rinsing with reverse osmosis-treated water. The sample volume should be 100 ml of dialysate or 1 liter of untreated water. The sample should be poured into a clean glass container with a tube or hose, coming into as little contact with air as possible. The pH-value must be measured immediately in the same container. Make sure that the display stabilizes before the value is read.

In stirred solutions the response rate is faster; the value, however, must be measured at resting fluid.

The pH-electrode must be dabbed only with a lint-free cloth and never rubbed dry. Rubbing destroys the jelly layer on the glass surface which results in a longer response time for the electrode.

Before taking measurements, remove the rubber cap. If the mobility of the plastic part is restricted it can be released by rinsing with lukewarm water.

Pressure and fluid currents have considerable influence on the pH measurements. Therefore, it is essential to take the pH measurement in a resting solution at environmental pressure.

If you would like to learn more about pH please visit the following WEB sites:

The pH Measurement Information Resource
This site provides comprehensive information on the theory and practical application of pH measurement.

http://www.ph-measurement.co.uk/

Acids and Bases – pH Tutorial

http://www.science.ubc.ca/~chem/tutorials/pH/

pH-calibration in the measuring mode

```
 ┌─────────┐    ┌─────────┐    ┌─────────┐    ┌─────────┐
 │ -adjust- │    │ -adjust- │    │ -adjust- │    │  HDM99  │
 └─────────┘    └─────────┘    └─────────┘    │  adjust │
                                               └─────────┘
  measure pH     measure pH     pH-param.
        pH             pH       grad:  99%
    3.82           5.85         temp:  25°C
   ▬▬                ▬▬▬▬▬▬
  ┌┬─┬─┬─┬┐       ┌┬─┬─┬─┬┐     pH-value1
  2    7   12     2    7   12   old:   3.82       data
    please         please      new:   4.00      saving
     enter          enter                          now
   1st value      2nd value     pH-value2

    04.00          06.00        old:   5.85
                                new:   6.00
   for quit       for quit      ┌─────────────┐
    press          press        │ ok        > │
   >ENTER<        >ENTER<       └─────────────┘

 ┌─────────────┐ ┌─────────────┐ ┌─────────────┐
 │ cancel    > │ │ cancel    > │ │ cancel    > │
 └─────────────┘ └─────────────┘ └─────────────┘
```

Calibration

Before the adjustment the kind of temperature calibration must be set already.
Prepare two buffer solutions. The two buffers should not differ more than two activation decades. Choose, for example, pH4 and pH6. Carefully remove the protection hood for the measurement. Rinse and dab the pH electrode with distilled water before dipping it into the buffer. If necessary wash and dry the temperature sensor likewise, and put it into the measuring beaker. Wait until the display remains stable, then enter the pH-value via the numeric keyboard. Confirm your input with > *ENTER* <. Then wash and dry the electrode and dip it into the second buffer. When the value of the second buffer is entered, the display shows the actual calibration. If thereby the graduation (grad) is lower than 85%, the electrode could be worn out and must be replaced by a new one.
If you try to enter two equal values the reference *invalid data* appears after confirming with *ok*; at correct input the data will be saved, and you will return to the menu for the parameter setting.

Flow measuring

```
┌──────────┐              ┌──────────┐
│ meas.S 1 │              │parameter │
└──────────┘          ┌───│  flow    │
                      │   └──────────┘
 flow                 │
      ml/min          │
    1049              │   ┌──────────┐
 ▬▬▬▬▬▬▬▬▬▬▬          │   │filter. ↑ │
 0  1000 2000         │   ├──────────┤
 Att:  2sec           │   │  1.0 sec │
                      │   │█2.0█sec█ │
 quantity             │   │  5.0 sec │
       ml             │   │ 10.0 sec │
    2231              │   │ 20.0 sec │
                      │   │ 30.0 sec │
 ┌──────────┐         │   │ 40.0 sec │
 │ Reset   >│         │   └──────────┘
 └──────────┘         │   │filter. ↓ │
                      │   └──────────┘
 ┌──────────┐         │
 │ param.  >│─────────┘   ┌──────────┐
 └──────────┘             │ ok      >│
                          └──────────┘
 ┌──────────┐
 │ menu    >│             ┌──────────┐
 │ measure  │             │ cancel  >│
 └──────────┘             └──────────┘
```
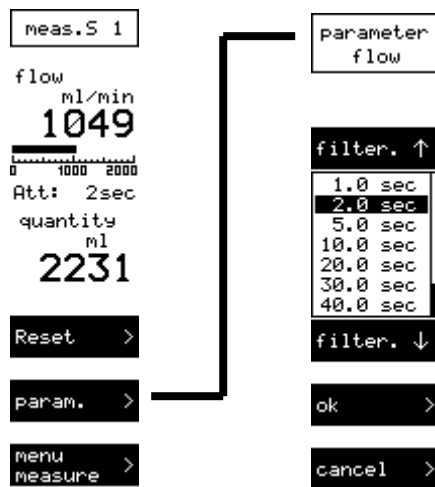
The current flow rate and the amount of flown liquid will be shown. The amount of flown liquid
can be restored to zero by pushing *Reset.*
The Parameter Button leads to the selection menu for the flow rate reduction.
An average flow rate is determined by setting a time (limit) in this display/menu. The selected
reduction value is displayed in the measurements window behind the "Att:' Sign.

Management of different sensors

For the measuring of the flow different sensors will be used according to the measuring unit.
The HDM99 governs up to 15 different sensors. For detecting the different sensors a code is put
on them. This code is used for the internal choice of calibration data. The number of the
connected sensors will be shown in the display.

Any sensor can be used which has an output signal that delivers a frequency proportional to the
flow running. The amplitude at the entrance of the HDM99 may have a range of 5...24 V. For
the current supply of the sensors 5 V DC/ 10 mA are available at the connection of the flow
measuring.

Connection occupancy of the plug connection for the flow measurement

Pin	Meaning
1	currency supply sensor 5 V/ max 10 mA
2	signal input 5...24 V max 1 MHz
3	GND
4	code input 0
5	code input 1
6	code input 2
7	code input 3
8	shield for supply

Codes for the different sensors

Sensor	Pin 4	Pin 5	Pin 6	Pin 7	Remark
1	GND	GND	GND	GND	IBP Sensor 1
2	5 V	GND	GND	GND	IBP Sensor 2
3	GND	5 V	GND	GND	IBP Sensor 3
4	5 V	5 V	GND	GND	IBP Sensor 4
5	GND	GND	5 V	GND	IBP Sensor 5
6	5 V	GND	5 V	GND	IBP Sensor 6
7	GND	5 V	5 V	GND	IBP Sensor 7
8	5 V	5 V	5 V	GND	IBP Sensor 8
9	GND	GND	GND	5 V	
10	5 V	GND	GND	5 V	
11	GND	5 V	GND	5 V	
12	5 V	5 V	GND	5 V	
13	GND	GND	5 V	5 V	
14	5 V	GND	5 V	5 V	
15	GND	5 V	5 V	5 V	

If you use your own sensors, please choose a code beginning at number 9. The numbers 1...7 are reserved for the IBP sensors.
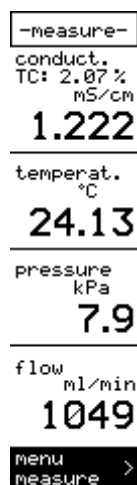
Frequency – Period time – Counter
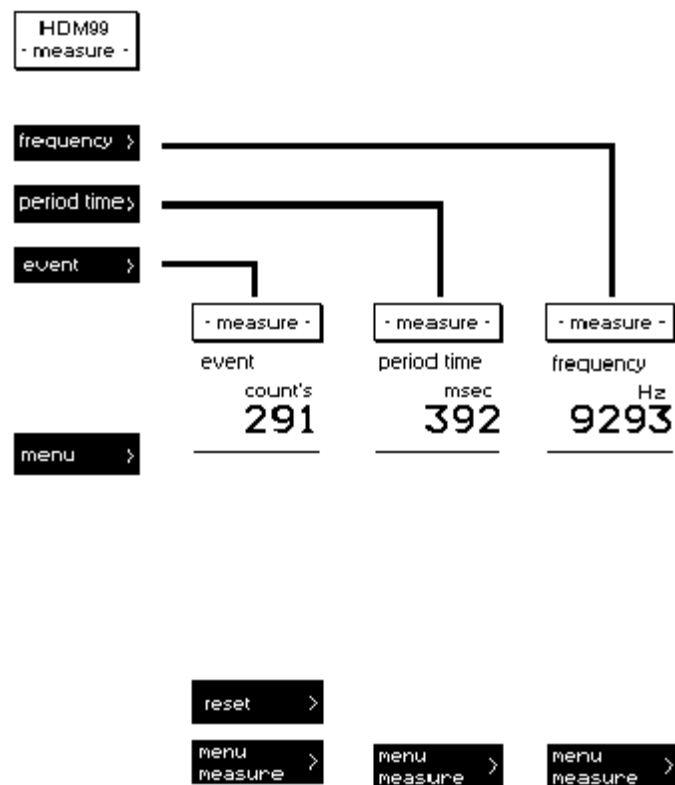
By operating one of the three functions you get optionally to the measuring menu for
frequency, period duration , or event measuring.
All measurements can be done up to a frequency of 250 kHz. In the event measuring, the
counted events can be reset to zero by operating *reset*.

Pool menu

```
 ┌─────────┐
 │-measure-│
 └─────────┘
  conduct.
  TC: 2.07 %
        mS/cm
   1.222
 ─────────────
  temperat.
      °C
   24.13
 ─────────────
  pressure
      kPa
     7.9
 ─────────────
  flow
      ml/min
   1049
 ┌─────────┐
 │menu     │
 │measure  >│
 └─────────┘
```

Pool is a menu in which the following channels are displayed simultaneously:

<div align="center">

Conductivity
Temperature
Pressure
Flow.

</div>

All necessary settings, e.g. the temperature coefficient for the conductivity measurement or the unit for the pressure measurement, are taken from the corresponding measurement menus and can also only be changed there.

Voltage measurement - plotter

Time range

By activation of the function key *param.* you will receive a menu which allows to change the *time range* in which the graph will run through horizontally once. Long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or - like in the example - further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

Damping

By operating the function key *damping* you will get a time table with a choice of periods between zero and ten seconds. Those can be chosen in the usual way with the function keys beside the arrows upward or downward. By use of the chosen period of time a gliding average value of the measured voltage will be calculated and put on display.
Please note that voltage sways which are shorter than the selected damping period can not be recorded.

Voltage display

In the beam display the momentary value of the voltage is displayed. The voltage measurement in the plotter mode is particularly feasible for the measurement of voltages which are subject to no fast sway, therefore DC voltages and low frequency AC voltages.

Filter

By choice of the function key *filter* you will receive a time table with periods between zero and 10 seconds to select. Those can be operated in the familiar way with the function keys beside the arrows. An average value of the measured voltage over the selected period is calculated and reported. Please note that voltage sway which is shorter than the selected filter period can not be recorded.

Voltage measurement – oscilloscope

Time range

By activation of the function key *param.* you will receive a menu which allows you to change the *time range* in which the graph will run through horizontally once. Long term measurements up to twelve hours are possible. Since you do not have all possible times presented simultaneously, a black beam on the right side shows that above, or - like in the example - further options hide themselves below.

The selected *time range* is shown inverted. To change the *time range*, operate the function keys beside the arrows upward or downward. When you have selected the suitable *time range* for your application, return to the temperature measurement with the activation of *ok*. The length of the horizontal axis of the graph now corresponds to the chosen *time range*.

Voltage Display

In the beam display the R.M.S. value of the voltage is shown. The voltage measurement in the oscilloscope mode serves mainly for the measurement of voltages subject to higher frequency, therefore also AC voltages.

Measuring range

By activating the function key *y-range* it is possible to select a measuring range for the vertical axis of the graph via the arrow-keys which allows a maximum resolution of the voltage graph. The chosen measuring range is shown inverted. With the *ok*-key you transfer it to the voltage measurement.

Trigger

With this function key you will get to a menu where you can adjust the mode of the measurement triggering. Press the keys beside the arrows until the desired triggering is presented inverted. In detail the options mean:

No trig.	The applied voltage is shown without triggering.
+ AC	The rising edge of the average value of the applied voltage is triggered.
- AC	The falling edge of the average value of the applied voltage is triggered.
+DC	The rising edge at the zero passage of the voltage is triggered.
-DC	The falling edge at the zero passage of the voltage is triggered.

Take over the chosen triggering with the *ok*-key, and return to the voltage measurement. Please note that a successful triggering can only take place if a suitable voltage signal is applied. Otherwise >no trigger< appears in the graphic display.

Battery voltage

Charging state of the battery

If you select the function *battery* you will receive an information display about the battery
voltage and the charging time.
The charging state of the installed accumulators can be estimated by the battery voltage. Above,
you see from left to right the displays for empty, half and full.

```
 -measure-      -measure-      -measure-

batterie       batterie       batterie
       Volt           Volt           Volt
  4.32           5.24           5.74

40   50   60    40   50   60    40   50   60

chargetime     chargetime     chargetime
 00:00          02:18          05:30

                fastcharge
                  aktiv!


menu    >      menu    >      menu    >
measure        measure        measure
```
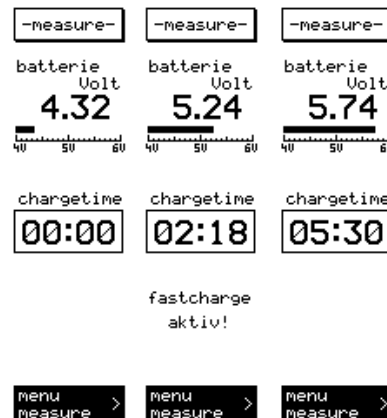
The computer processed charging starts with the connection of the charging device. There are
two modes of charging, quick-charge and trickle. The light-emitting diodes beside the charging
socket indicate these modes. Green stands for trickle, and the red LED indicates quick-charge.
In all working modes the empty battery is indicated as >*Low-Bat*< in the uppermost menu field.

With activation of the key *measuring* you will return to the measuring menu.

To avoid fail functions never use the HDM99 without batteries.

**To avoid hazardous voltages in case of a defective battery charger never use the HDM99
on a dialysis machine with a connected battery charger.**

Calibration and Verification

To avoid confusion let us explain first what is calibration and what is verification.

- **Calibration** is the correction of a measuring channel
- **Verification** is the checking of the instrument with a known reference value

Anytime a calibration is made to the meter, verification is required to ensure accurate operation.
Anytime that improper function is suspected, verification and/or calibration are required.
Each measurement parameter is calibrated in a slightly different manner, so be sure to read the
instructions carefully before proceeding.

- The conductivity is calibrated by measuring the cell constant. Due to the high linearity of
  the probe only one calibration point is necessary for this.
- The temperature and pressure sensors do not drift, no calibration is necessary after
  manufacturing. The calibration is done at six points for increased accuracy
- The pH measurement is calibrated at two points.

If at any point during calibration, you are unsure whether you have correctly entered all values,
you can exit without saving any calibration values. After you have done so, no calibration is
performed and you can start again from the beginning. The necessary steps for exiting the
calibration procedure are described in detail below.
If a calibration is incorrect, you have the option of accepting the standard values for every
measurement mode. Refer to the Standard Values section for details.

Handling of Standard Solutions

IBP Instruments standard solutions are produced under ISO9001 quality management. They are traceable to NIST and PTB Standards Reference Materials and are sealed with tamper-evident packaging.

To ensure standard solution and calibration/verification accuracy

- Keep solutions tightly capped to avoid evaporation
- Do not return used solutions to the storage bottle
- Do not remove solutions from their original bottle
- Keep the solutions in a cool place
- Use only fresh reference solutions for calibration and verification
- Use the solution immediately after pouring, evaporation will cause errors
- Discard solution the appropriate number of days after opening the bottle
- Discard solution after the expiration date

Calibration of the HDM99
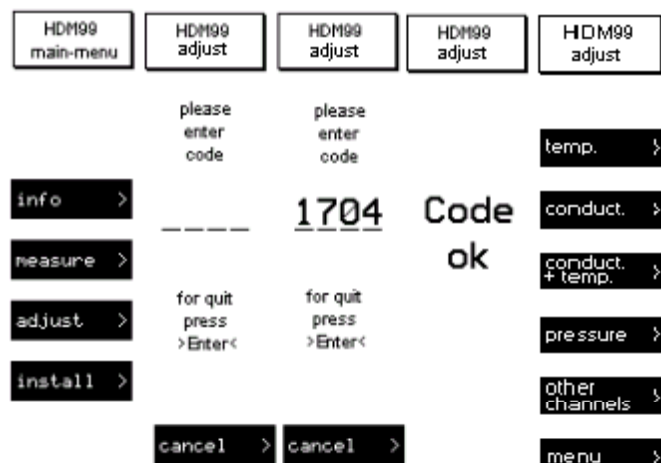
The entire calibration of the device is software controlled. Operate the function key *adjust* in the main menu to reach this function. You will be asked to enter a code via the numeric keyboard. This code is also **1704,** and must be confirmed with >*ENTER*<. After that, you are in the *adjust* menu.

The adjustment of the individual channels is slightly different. The pH- and voltage measurement is adjusted at two points. The temperature and pressure measurement is adjusted at minimally two points, alternatively up to six points. The advantage of more than two calibration points is the higher precision of the measurement as the non-linearity of the sensors will be equalized . The sequence of the calibration in reference to the level of the values is insignificant. Please note, that each value may be entered only once, since the system does not accept the data otherwise. The display will show *invalid data*.
The conductivity calibration results from measuring the cell parameter. Only one calibration point is necessary here.
The calibration of the flow measurement results from measuring of the impulses per liter. Up to 15 different sensors can be calibrated. Only one calibration point is necessary for this.

Should you be uncertain if you have entered all values correctly at any point in the run of the calibration of the device, choose the function >*cancel*<. Then no calibration will be accomplished, and you can start again.

Should a calibration prove to be incorrect you can reset this calibration by the function *calibration reset* within the installation menu.

Temperature Calibration

Because these sensors do not drift, normally no calibration is necessary after manufacturing.

```
 -adjust-     -adjust-     -adjust-     -adjust-     -adjust-     -adjust-
                           -temp-                    -temp-
 temperat.    temperat.                 temperat.                 temperat.
    °C           °C                        °C                        °C
   0.7         20.7                      40.1                      61.3

 |.......|     |.......|                 |.......|                 |.......|
 0  40  80     0  40  80                 0  40  80                 0  40  80

  please        please      another      please      another      please
   enter         enter       input >      enter       input >      enter
 1st value     2nd value                3rd value                4th value
                            stop   >                 stop   >
   01.0          21.0       input         40.5       input         61.8

 for quit      for quit                 for quit                 for quit
  press         press                    press                    press
 >ENTER<       >ENTER<                  >ENTER<                  >ENTER<

 cancel  >     cancel  >    cancel  >    cancel  >    cancel  >    cancel  >
```
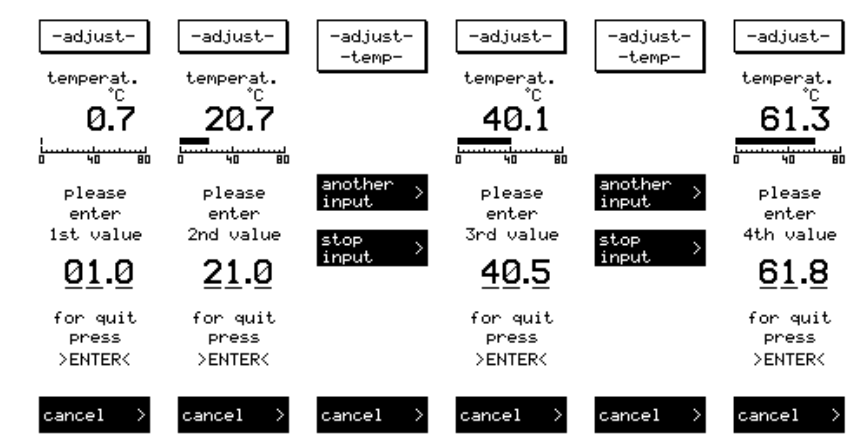
The calibration is to be accomplished as follows: Operate the function key *temp.* and follow the instructions on the display.
The temperature sensor is dipped into a fluid with known temperature, this temperature is then entered to the HDM99 via the numeric keyboard and confirmed with >*ENTER*<. The calibration points should be at the following points: 20 °C, 30 °C, 36 °C, 38 °C, 45 °C and 80 °C. After you have entered the last value press the function key *stop input*. If a higher precision is required at temperatures around 80 °C you can enter further calibration points at 60 °C and 85 °C. In this case choose *another input*.
The calibration value must be entered only if the displayed values are stable.

```
 -adjust-      HDM99       -adjust-      HDM99       -adjust-      HDM99
 -temp-        adjust      -temp-        adjust      -temp-        adjust


 temp./°C                  temp./°C                  temp./°C
 tp1:  1.0                 tp1: 40.5                 tp1:  1.0
 tp2: 21.0                 tp2:  1.0                 tp2: 21.0
 tp3: 40.5      data       tp3: 61.8      data       tp3: 21.0     invalid
 tp4: 61.8     saving      tp4: 21.0     saving      tp4: 40.5      data
 tp5: --.-      now        tp5: --.-      now        tp5: 61.8
 tp6: --.-                 tp6: --.-                 tp6: --.-


 ok     >                  ok     >                  ok     >

 cancel >                  cancel >                  cancel >
```
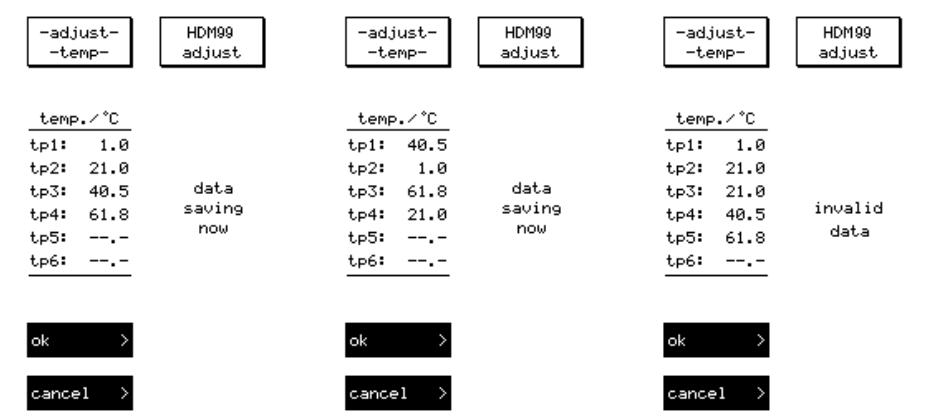
Conductivity Calibration

Reference temperature

-adjust- conduct.	-adjust-	-adjust-	-adjust- conduct.	HDM99 adjust

ref.- temp. >	enter ref.-temp. by °C	enter ref.-temp. by °C	ref.-temp. old: 25 °C new: 18 °C	
temp.- coeff. >			tcoeff. 2.070%	data saving now
measure cellpar. >	**25**	**18**	cellparam. 0.6050	
input cellpar >	for quit press >ENTER<	for quit press >ENTER<	ok >	
cancel >	cancel >	cancel >	cancel >	

The usual reference temperature is 25 °C. For special applications other values can be used.

Use this function only if you are aware of the consequences. By using wrong values you will get a wrong conductivity value.

You reach this function by calling the menu point *ref.-temp.* There you can enter the new reference temperature via the numeric keyboard and confirm it with *>ENTER<*. By activation of the *ok*-key the new reference temperature will be saved in the software.

Temperature coefficient

For dialysate, the temperature-coefficient of the solution to be measured is 2.070%. This is the value for NaCl-Solutions. For special applications this factor can be changed.

```
┌──────────┐     ┌──────────┐     ┌──────────┐
│ -adjust- │     │ -adjust- │     │ -adjust- │
└──────────┘     └──────────┘     │ conduct. │
                                  └──────────┘

   please           please          t.-coeff.
   enter            enter           old:2.070%
  temp-coeff       temp-coeff       new:2.405%
    by %             by %
                                    ref.-temp.
   2.070            2.405             18 °C

  for quit         for quit         cellparam.
   press            press            0.6050
  >ENTER<          >ENTER<
                                  ┌──────────┐
                                  │ ok     > │
                                  └──────────┘
 ┌──────────┐   ┌──────────┐   ┌──────────┐
 │ cancel > │   │ cancel > │   │ cancel > │
 └──────────┘   └──────────┘   └──────────┘
```

Use this function only if you are aware of the consequences. By using wrong values you will get wrong conductivity values.

You reach this function by calling the menu point *temp.-coeff.* You can enter the new temperature coefficient via the numeric keyboard and confirm it with >*ENTER*<. Pressing the OK button transfers the new temperature coefficient to the program, but it is not used until it is selected in the parameters menu for Conductivity and Conductivity + Temperature.

By operating the menu point *conductivity range* you can choose the correct range with the arrow-keys. While calibrating the solution should have a temperature of approximately 25 °C. As soon as the measuring value in the display is stable the calibration value of the solution can be entered by the numeric keys and can be confirmed with >ENTER<.
After the calibration, all values relevant for the conductivity measuring will be indicated once more. By operating the ok-key all data will be saved.

Measuring of the cell parameter

Before this function can be used, the reference temperature must be adjusted. It is sufficient for the conductivity calibration to know the cell parameter. If this is not known, or has been changed after longer use by deposits on the electrode, this function can be used to define the cell parameter newly. Call the function *measure cellpar.*in the adjust-menu.

Materials needed: HDM99 meter with attached conductivity/temperature probe, 13.63 or 14.0 ms/cm Conductivity Standard Solution, clean glass container.

In this function the measuring range will not be adjusted automatically. The adjustment for dialysate should be in the area of 13...14 mS/cm. Therefore the measuring range must be 0...20 mS/cm. If the measuring range is too small, the device indicates the overflow with >*OFL*< above the beam display. Via the menu point *measure conduct* you can choose the correct measuring range with the arrow-keys. During the calibration the standard solution should have a temperature of approx. 25 °C. When the measurement value in the display is stable, the conductivity value of the standard solution ca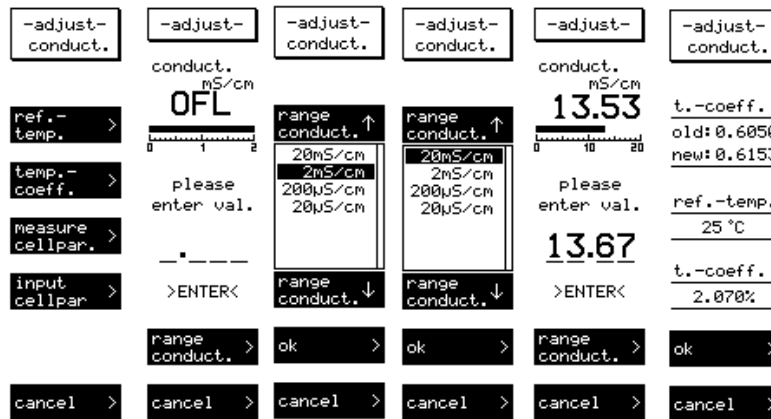n be entered via the numeric keyboard and confirmed with >*ENTER*<. After the calibration, all values relevant for the conductivity measurement are indicated once more. With the *ok*-key the data will be saved.

Enter cell parameter
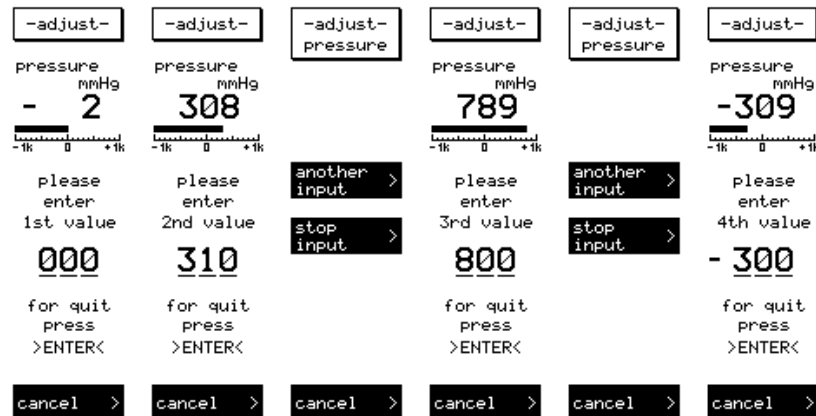
It is sufficient to enter the cell parameter of the electrode if it is known. This is profitable for an exchange of the electrode. Choose the function *input cellpar*. Enter the cell parameter via the numeric keyboard and confirm it with >*ENTER*<. Subsequently, all values relevant for the conductivity measurement will be indicated once more. With the *ok*-key the data will be saved.
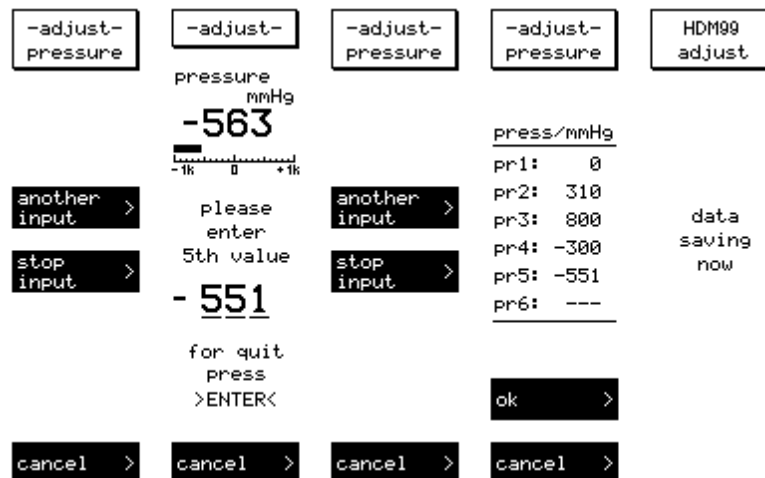
Pressure Calibration

Because these sensors do not drift, normally no calibration is necessary after manufacturing.

-adjust-	-adjust-	-adjust- pressure	-adjust-	-adjust- pressure	-adjust-
pressure mmHg	pressure mmHg		pressure mmHg		pressure mmHg
- 2	308		789		-309
please enter 1st value	please enter 2nd value	another input >	please enter 3rd value	another input >	please enter 4th value
000	310	stop input >	800	stop input >	- 300
for quit press >ENTER<	for quit press >ENTER<		for quit press >ENTER<		for quit press >ENTER<
cancel >	cancel >	cancel >	cancel >	cancel >	cancel >

Operate the function key *pressure* in the adjust-menu. The calibration of the pressure measurement works like described for the temperature calibration at up to six points. After the input of two points you have the choice whether to terminate the calibration (function *stop input*), or to enter further values (function *another input*). The pressure probe is applied with known pressure, and then the values will be entered successively via the numeric keyboard and confirmed with >*ENTER*<. The calibration points for the measurement on dialysis machines should be at -400, -100, 0, +100 and +500 mmHg. If you call the function *stop input* after your input, the entered values will be indicated once more, and can be taken over with the *ok*-key.

-adjust- pressure	-adjust-	-adjust- pressure	-adjust- pressure	HDM99 adjust
	pressure mmHg		press/mmHg	
	-563		pr1: 0	
another input >		another input >	pr2: 310	
	please enter 5th value		pr3: 800	data saving now
stop input >		stop input >	pr4: -300	
	- 551		pr5: -551	
			pr6: ---	
	for quit press >ENTER<		ok >	
cancel >	cancel >	cancel >	cancel >	

The calibration values must be entered only if the values on the display are stable. The sequence of the calibration in reference to the level of the values is insignificant. Please note that each value may be entered only once since the system does not accept the data otherwise.

pH Calibration

Please read the section Fundamental information about pH-measurement.

-adjust- - pH -	parameter adjust	-adjust- measure pH pH **3.82**	-adjust- measure pH pH **5.85**	-adjust- pH-param. grad: 99%	HDM99 adjust
	please enter temp by °C			temp: 25°C	
t-comp. measure >		please enter 1st value	please enter 2nd value	pH-value1 old: 3.82 new: 4.00	data saving now
t-comp. input >	**25.0**	**04.00**	**06.00**	pH-value2 old: 5.85 new: 6.00	
volt./pH >	for quit press >ENTER<	for quit press >ENTER<	for quit press >ENTER<	ok >	
cancel >	cancel >	cancel >	cancel >	cancel >	

Temperature compensation of the pH-measurement

For the temperature compensation of the pH-measurement the device offers two possibilities. The solution temperature can be measured via the conductivity and temperature-electrode, or entered by hand. The chosen type of the calibration is check-marked in the menu point *measure t-comp* or *enter t-comp*. If you select *measure t-comp.* no further input is necessary. The temperature will be measured via the measuring cell, and you will get to the pH-measurement automatically.

By choice of *enter t-comp.* you will be asked to enter the solution temperature via the numeric keyboard. After confirmation with >*ENTER*< you will return to the menu for the parameter setting

By choice of the function *calibration* you will reach the pH-calibration directly. The device uses 25°C as default.

How to calibrate pH:
Materials needed: HDM99 meter with attached pH probe, conductivity/temperature probe (optional), high and low value pH Standard Solution (see below), two clean glass containers.

Before calibration the type of temperature calibration must be selected already. Prepare two buffer solutions. The two buffers should not differ more than two activation decades. Choose, for example, pH4 and pH6. For the measurement remove the protection hood carefully. Rinse and dab the pH electrode with distilled water before dipping it into the buffer. If necessary wash and dry the temperature sensor likewise, and put it into the measuring beaker. Wait until the display shows a stable value, and then enter the pH-value via the numeric keyboard. Confirm your input with > *ENTER* <. Then wash and dry the electrode, and dip it into the second buffer. When the value of the second buffer is entered, the display shows the actual calibration. If

thereby the graduation (grad) is lower than 85%, the electrode could be worn out and must be replaced by a new one.

If you try to enter two equal values, the reference *data invalid* appears after confirming with *ok*. At correct input the data will be saved, and you will return to the menu for the adjustment.

Flow Calibration

```
 -adjust-      -adjust-
  flow          flow


     no      flow     >                                                        
  sensor     measure
 detected!
             impulse  >
             input

             impulse  >
             counter
                          adj. s 1   adj. s 1   adj. s 1   adj. s 1
  ok      >  range    >

                          enter      impulse               flow
  cancel  >  cancel   >  maximum      50057               ml/min
                          flow       ────────              726
                                      flow       enter
                                     ml/min 726  impulse    ┃━━━━━━━━
                                     ────────    per litre  0   1000  2000
                                     quantity
                          02000       in ml                please
                          >ENTER<    enter val.            enter val.

                                      5000      36000      0730
                          select     >ENTER<    >ENTER<    >ENTER<
                          unit

                          ┌ml  > ┐   reset    >

                          cancel >   cancel >  cancel >   cancel >
```

You will get to this function by operating the menu point *flow*. Up to 15 different sensors will be governed automatically. For calibration the correct sensor must be applied. In case that no sensor should be connected, a fault notice will occur. The running number of the recognized sensor will appear in the following presentations in the upper display. (Look also in the manual under flow measurement)

There are three different ways to calibrate a flow sensor.

- **Given amount of flow in ml/min or l/min**

- **Given number of impulses per liter**

- **Given amount of the quantity that has flown through**

Generally the sensor should be calibrated in the middle of the used measuring range.

Example: The sensor has a measuring range of 100... 2000 ml/min.
Operation range 100...600 ml/min. Then the calibration should be done around 350 ml/min.

Given amount of the quantity that has flown through

This way of calibration should only be used if no other possibility is available.
Ensure the constant flow through the sensor. Then enter the amount of the quantity that has
flown through with the chosen unit, and confirm with *Enter*.
Check the calibration once again. This way the calibration is complete.

Given number of impulses per liter

This type of calibration should be used if the value is known.
Enter the value for the number of impulses/liter and confirm with *Enter*. This way the
calibration is complete.

Given amount of the flown quantity

This type of calibration is the safest way to get to an exact result. Here the amount that has
flown through the sensor within 5...10 min will be measured, and this value will then be entered.
The HDM99 uses the value to calculate the impulses/liter. If you change to the menu point *enter
impulse* after this calibration, you will get the new calibration value there.
Check the calibration once again. This way the calibration is complete.

Voltage Calibration

```
┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐
│-adjust- │  │-adjust- │  │-adjust- │  │ HDM99   │  │-adjust- │  │ HDM99   │
│         │  │         │  │voltage  │  │adjust   │  │voltage  │  │adjust   │
└─────────┘  └─────────┘  └─────────┘  └─────────┘  └─────────┘  └─────────┘

 voltage      voltage
      Volt         Volt
   0.12        19.93       val1/Volt                 val1/Volt
─────────    ─────────     old:  0.12                old:  0.12
-20  0 +20   -20  0 +20    new:  0.00                new:  0.00
                                          data
  please       please                    saving
  enter        enter       val2/Volt      now        val2/Volt
 1st value    2nd value    old: 19.93                old: 19.93    invalid
                           new: 20.00                new:  0.00     data
  00.00        20.00
                           ┌─────────┐               ┌─────────┐
 for quit     for quit     │ok     > │               │ok     > │
  press        press       └─────────┘               └─────────┘
 >ENTER<      >ENTER<
┌─────────┐  ┌─────────┐  ┌─────────┐               ┌─────────┐
│cancel  >│  │cancel  >│  │cancel  >│               │cancel  >│
└─────────┘  └─────────┘  └─────────┘               └─────────┘
```

You can reach this function by calling the menu point *voltage*. For the calibration of the voltage measurement you need two values. The calibration values should be at 0 and approx. 40 V=. The sequence of the calibration in reference to the size of the values is insignificant.
For the calibration value 0 V create a short circuit between the sockets. For other calibration values apply known voltages to the sockets.
The entering of the calibration values is carried out via the numeric keyboard. Please, pay attention that the values in the display are stable, then enter the calibration values, and confirm them with *>ENTER<*. After input of two calibration values the old and new values will be indicated once more, and can then be taken over with the *ok*-key.

Maintenance and Care

Generally the HDM99 can be considered as an easy-care instrument. Like all measuring instruments there is a minimum of maintenance and care necessary to ensure that all functions work flawlessly.

Operate the instrument only in a dry environment, and do not touch it with damp hands. Ensure that no fluids intrude into the interior of the device, or into the sockets at the front. If this ever happens, open the device and remove the batteries. Sink the whole device into a vessel with distilled water overnight. Afterwards, dry the HDM99, and send it to your distributor for repair.

There are no parts in the HDM99 which you can repair yourself. Contact our technical support team in the event of any malfunction. If the device should become damaged, or malfunction, send it to your distributor for repair.

Storage

Keep the device in a dry place. Suitable is, for example, the original packaging in which you have received the HDM99, or the carrying case offered by IBP as accessory. If you do not use the device over a longer period of time, you should connect it to the included charging device about every two weeks for one hour to avoid exhausting the batteries.

Cleaning

Never clean the device with any fluids! In case of pollution you can wipe the surface of the HDM99 with a dry and clean cloth. For measurements in the lower conductivity range, the cleaning of the conductivity/temperature measuring cell is recommended. Remove water-soluble substances by rinsing with deionized water, fats and oils with warm water and household dish washing detergent. Lime and hydroxid crusts can be dissolved by a 10% acetic acid solution. In each case, the measuring cell needs to be washed with deionized water after the cleaning. Basically, the conductivity measuring cell does not decay over time. Particular measuring media (for example, strong acids and caustic solutions, organic solvents), or too high temperatures shorten the service life considerably, and/or lead to damage.

Caring for the conductivity/temperature electrode

Thorough cleaning of the electrode is particularly important for measuring low conductivities. Water-soluble substances must be removed by rinsing with deionized water. Remove lime deposits with a 10% acetic acid solution. To do this, immerse the electrode in the solution for 24 hours, then rinse it thoroughly with deionized water. Do not touch the electrode surface with your fingers.   If necessary, clean the surface with acetone.

Calibration intervals

When delivered new from the factory, each device is adjusted before shipment. To ensure reliability, the different measuring channels have to be calibrated at fixed intervals to examine their precision. This can be done by measuring known sizes; for instance, standard solutions, or proof voltages. If the measured values should deviate from the below indicated permissible limits, a new calibration of the instrument is necessary. We recommend the following intervals for verifying calibration:

Parameter	Verification Frequency
Temperature	Once a Year
Conductivity	Once a Month
Pressure	Once a Year
pH	Before Each Use
Voltage	Once a Year
Flow	Once a Year
Frequency Period time Counter	Once a Year

Write down your calibration values and keep them until the next calibration. In case of damage, a calibration protocol can be important to help locate the problem.
If the calibration has been done by the IBP, a sticker will be put on showing the date of the next required calibration.

A complete function test and calibration of the device should be done once a year.

For liability reasons you should not carry out these tests and calibration and verification yourself. If IBP performs the calibration, you will receive a calibration certificate in accordance to ISO9001 which documents the calibration/verification results.

Recommended verification values and the allowed deviations

Measuring Channel	Verification Value	Allowed Deviation	Remark
Temperature	25.00 ^{O}C	$\pm$ 0.1 ^{O}C	
	34.00 ^{O}C	$\pm$ 0.1 ^{O}C	
	37.00 ^{O}C	$\pm$ 0.1 ^{O}C	
	40.00 ^{O}C	$\pm$ 0.1 ^{O}C	
	55.00 ^{O}C	$\pm$ 0.1 ^{O}C	
	80.00 ^{O}C	$\pm$ 0.1 ^{O}C	
Conductivity	74.00 μS/cm	$\pm$ 0.60 μS/cm	
	147 μS/cm	$\pm$ 0.60 μS/cm	
	720 μS/cm	$\pm$ 6.00 μS/cm	
	1410 μS/cm	$\pm$ 6.00 μS/cm	
	2.77 mS/cm	$\pm$ 0.03 mS/cm	
	6.70 mS/cm	$\pm$ 0.03 mS/cm	
	12.88 mS/cm	$\pm$ 0,03 mS/cm	
	16.00 mS/cm	$\pm$ 0,03 mS/cm	
Pressure	+ 190.00 kPa	$\pm$ 0,2 kPa	
	+ 110.00 kPa	$\pm$ 0,2 kPa	
	+ 50.00 kPa	$\pm$ 0,2 kPa	
	+ 10.00 kPa	$\pm$ 0,2 kPa	
	0.00 kPa	$\pm$ 0,2 kPa	Open Pressure Inlet
	- 10.00 kPa	$\pm$ 0,2 kPa	
	- 50.00 kPa	$\pm$ 0,2 kPa	
	- 80.00 kPa	$\pm$ 0,2 kPa	
pH	355.2 mV = pH 1	$\pm$ 0,02	
	177.6 mV = pH 4	$\pm$ 0,02	
	118.4 mV = pH 5	$\pm$ 0,02	
	59.2 mV = pH 6	$\pm$ 0,02	
	0 mV = pH 7	$\pm$ 0,02	
	- 59.2 mV = pH 8	$\pm$ 0,02	
	-118.4 mV = pH 9	$\pm$ 0,02	
	-177.6 mV = pH 10	$\pm$ 0,02	
	-355.2 mV = pH 14	$\pm$ 0,02	

Voltage	+ 35 V	± 0,05	
	+ 20 V	± 0,05	
	+ 10 V	± 0,05	
	0 V	± 0,05	
	- 10 V	± 0,05	
	- 20 V	± 0,05	
	- 35 V	± 0,05	
	+ 35 V	± 0,05	
Frequency	1000 Hz	± 1 Hz	
	10000Hz	± 1 Hz	
	100000 Hz	± 1 Hz	

Specifications

Conductivity

0 to 23.99 mS/cm in 4 ranges, quadro-pole-electrode,
Precision: 12.5…16.0 ms/cm ± 0.03 ms/cm, otherwise ± 0.3% of full measuring range.

Range	Resolution
0.0 - 19.99 µS/cm	0.01 µS/cm
20 - 199.9 µS/cm	0.1 µS/cm
200 - 1999 µS/cm	1 µS/cm
2.00 - 23.99 mS/cm	0.01 mS/cm

Reference temperature 25° C   Temperature compensation with 2.07 % per °C
                                                          adjustable from 0.00% to 4.00% per °C

Temperature

Range   0 … 100 °C,
Resolution   0.01 °C
Accuracy   25 … 40°C ± 0.07 °C otherwise ± 0.1 °C

Pressure

Range   -700 … 1600 mmHg
Resolution   1 mmHg
Accuracy   ± 3 mmHg, (20 … 23 °C)
with Option BP
Range   -700 … 700 mmHg
Accuracy   0 … 300 mmHg, ± 0,8 mmHg
                         otherwise ± 2 mmHg

pH

Range   pH 0 … 14
Resolution   pH 0.01
Accuracy   pH ± 0.1
Temperature compansation manually or via probe in combined electrode.

Voltage

Range   ± 40 V AC/DC
Frequency   up to 3 kHz
Resolution   0.01 V
Accuracy   ± 0,2% from full scale value

Flow

Range   100 … 2000 ml/min
Resolution   1 ml/min
Accuracy   ± 0.5% from full scale value

Frequenz

Range   250 kHz
Input voltage   5...24 V
Resolution   1 Hz
Accuracy   ± 0.2% from full scale value

Period Duration

Range   bis max. 1000 sec
Input voltage   5...24 V
Resolution   1 msec
Accuracy   ±0.2% from full scale value

Pulse/Event

Range   99999
Input voltage   5...24 V

Power supply

Internal Ni-MH battery rechargeable
Operating time, depending on operating mode, approx. 9.5 hours.
External charger
        Input Voltage
          Europe   220 V/ 50Hz
          International   100 … 245 V / 50/60 Hz
        Output Voltage   12 V DC, 500 mA,

Size and weight

Approx. 270 x 120 x 50 mm
Weight 900 grams without battery charger or probes.

PC-Interface

RS-232-Interface

**To avoid current loops use the RS232-Interface only with
notebooks which are not connected with the battery charger.**

Pin occupation of the RS-232-Interface

HDM99		Computer	
Pin Number	Signal	Pin Number	Signal
2	RxD	3	TDX
3	TxD	2	RXD
5	GND	5	GND

Interface parameters
The following interface parameters are fixed in the instrument

Baud rate 9600
Parity   **None**
Data bits   **8**
Stop bit   **1**

Interface from PC to HDM

9-pin D-Sub from PC (female)

1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9
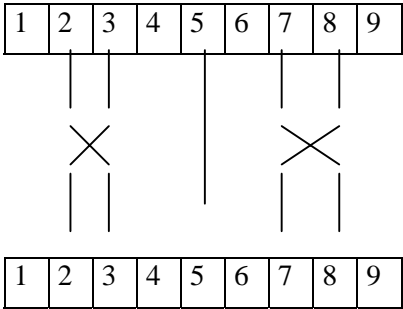
9-pin D-Sub to HDM (female)

Data transfer

To receive measurements by the HDM99 via the serial interface, the following abbreviations must be sent via the interface. The entire communication takes place in readable ASCII-characters.

Command to HDM99	Reaction of the HDM99
HDMCMO	Starts background measurement
HDMCMF	Ends background measurement
MRES	Reset unit counter for flow
HDMTARA	tares the Pressure measurement
hdm	Fetches measured values via the RS232 interface

Procedure

Before the measurement values are transmitted, the HDM99 must be initially set to the HDMCMO command. Subsequently the measurement values can be transmitted with the "hdm" command. The HDM99 sends a command line after the hdm containing 77 characters, followed by CR+LF.
MRES and HDMTARA commands can be executed at all times. When no farther measurement data is sent via the serial interface, finish the transmission with the HDMCMF command.

Notes

Any changes made to the settings of the HDM99 during the serial transmission (flow rate reduction, temperature compensation of conductivity measurements, etc.) may cause measurement errors. All changes and modifications of the settings should be made prior to the data transmission.

Format of Data

Response of HDM99 after sending the command *hdm*:

```
_12716.30/25.233/-1496.38/_7.99/-30.06/_0.00/4.96/_2000/__1200/
_20000/_12000 + CR LF = 79 characters.
```

Suppressed characters in front of the decimal point are shown as '_'.

The measuring values are send by the HDM99 in the following order:

Conductivity in µS/cm	9 signs
Temperature in °C	7 signs
Pressure in mmHg	8 signs
pH	5 signs
VDC in V	6 signs
VAC in V	5 signs
Vbattery in V	4 signs
Flow in ml/min	5 signs
Frequency in Hz	6 signs
Quantity in ml	6 signs
Event	6 signs
CR, LF	2 signs

The values are separated by '/'.

HDMView

Version 3.02

HDMView is a program which allows the collection and visualization of data obtained by measurement with **HDM99**. Data are transferred via a serial interface from the **HDM99** to the PC.

HDMView is compatible with **Windows 95/98,Windows NT and Windows 2000.**

The program is divided into four sections:
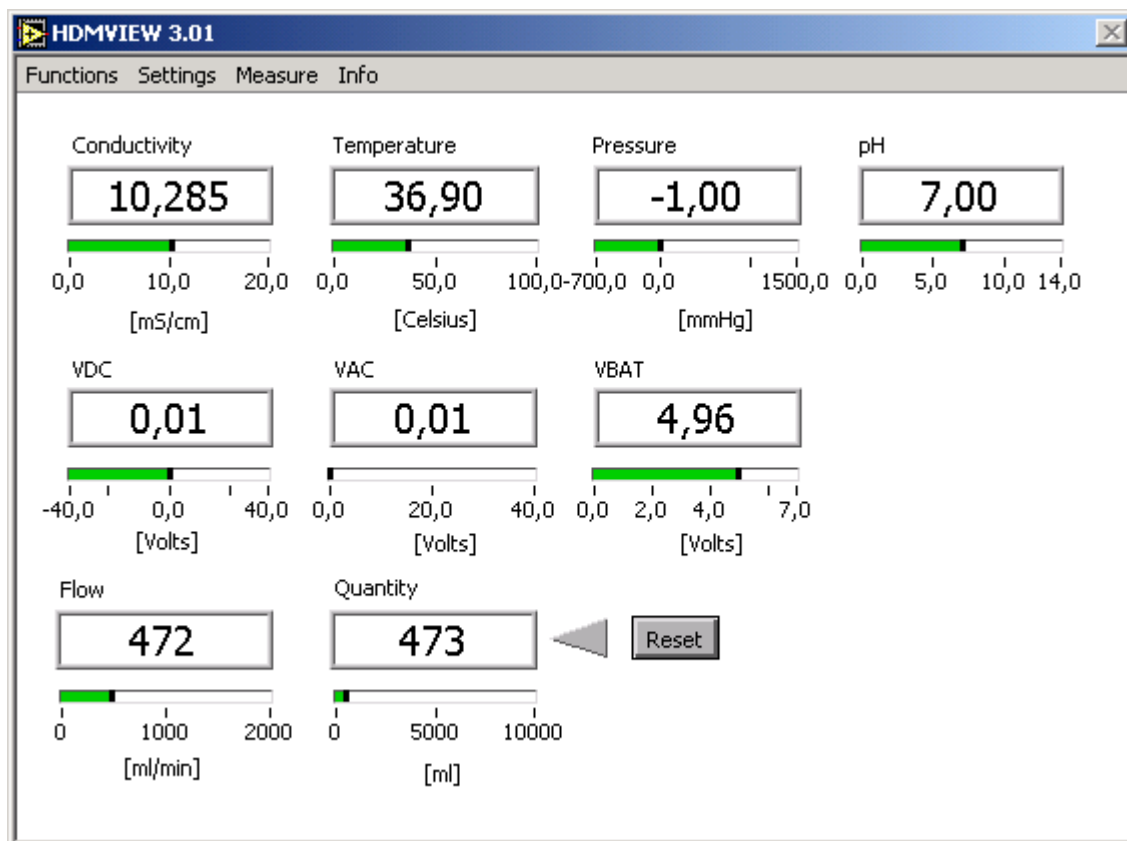
Main Window Digital view of all channels

Chart Window   Chart view of up to four channels

Alarm Window   Select and view alarm limit for all channels

Analysis Window   View and analysis of recorded measurement

All four windows may be used simultaneously.

Main Window

In this window all measured values which can be obtained using the **HDM97** are shown on a combined bar/digital display. If the pH sensor or the temperature/conductivity sensor are not connected, the message 'Disabled' will be displayed accordingly.

If values are outside the 'Select Alarm Ranges' ,pre-set measuring ranges, the relevant digital display flash red.
The scales on the bar display can be selected with the mouse and changed.

Menu items

<u>Functions</u>

  Chart View: Opens the window where up to four measurements
               are interactively shown in a diagram.

  Analysis: Opens the window which is used to show measured
               value files in diagrammatic form for analysis.

Alarm Window

In this window you can select minimum and maximum values for some of your measurements. They will be saved in the HDMVIEW.INI-file. If the measured value falls outside the alarm range, the relevant bar will show a flashing red light.

Menu items
   Settings

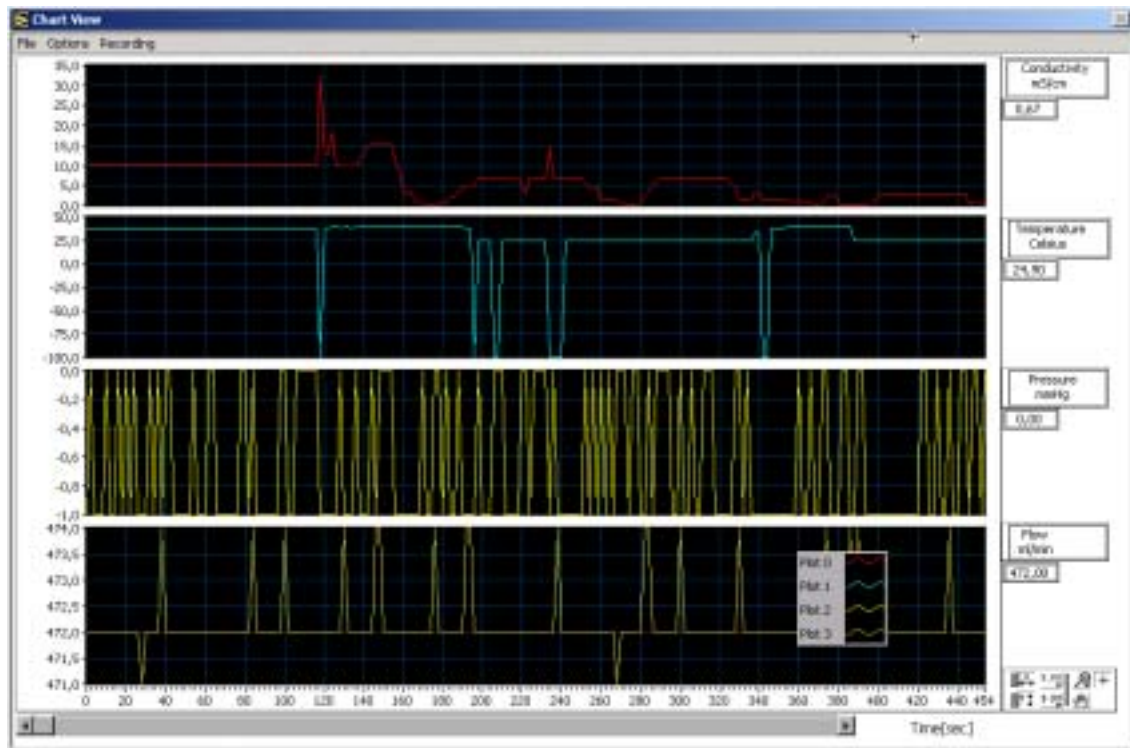   **Setup:**   This is the option for configuring your PC hardware.
                         Select your HDM-Model you have
                         (HDM90, HDM96, HDM97, HDM99)
                         as well as your serial interface (COM1..COM10).

   Measure

   Start Measure: Starts measurement.
   Stop Measure: Stops measurement.

Chart Window

This window allows interactive visualization of up to four channels. The appearance and function of the diagram can be modified. Use the right mouse button for the diagram. A pop-up-menu with a number of options will appear. For changing the time range of your measurement to be shown, click on the number to the right or left of the time axis. Type a new number and confirm with ENTER.

Menu items
  File

      Save,
      Save as: Measurements which have been displayed can be saved in MS-Excel format. With the 'Save' option the information will be stored in the directory selected under 'Select Path'. If no path is selected, a sub-directory will be created under the name of 'DATA' in the directory in which the program HDMVIEW.EXE is located. With save the file names are allocated as follows:

Name: **HDMYYMMDDhhmm**.xls

with   **YY**   year
        MM   month
        DD   day
        hh   hours
        mm   minutes

The times input relate to the starting time of the measurement S(Start Recording). The file name may be changed subsequently; the file suffix **.xls** must be retained.
With 'Save As' the file name (*.xls) may be freely selected.

      Quit: Closes the window.

  Options

      Channels: Up to four channels may be selected for the simultaneous recording of the various HDM measurements with different units.

      Select Path: Here you can select a standard path for your measuring files.

Recording

    Start: Starts recording the measured values that can later be saved in a file. While recording a red LED is shown in the lower right-hand corner of the window.

    Stop: Stops recording measured values.

Analysis Window
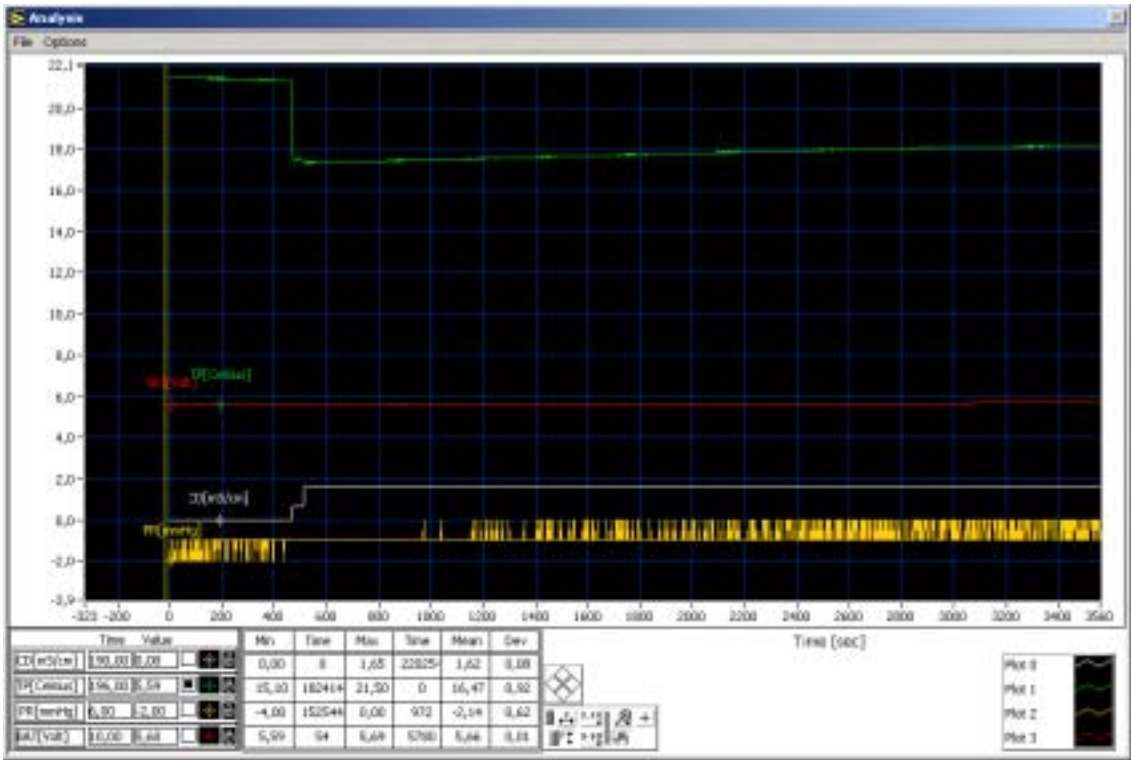
Analysis allows the loading and display of measuring files as a graph. The graph can be traced with a cursor.
The actual x and y values are printed below the graph. In addition
numerous values are listed in a table:

Max: Maximum value
Time: Point of time of the maximum value
Min: Minimum value
Time: Point of time of the minimum value
Mean: Mean value
Dev: Standard deviation

Menu items

File

Open:	A file dialog box enables a previously recorded measurement to be selected and shown as a graph.
File Information:	Shows when the file has been saved as well as any comments.
Save Time Range:	Allows certain time range for your measurement to be saved. This time range must be determined using "Select Time Range".
Print:	The complete window will be printed.
Quit:	Closes the window.

Options

Change Scales:	Allows a multiplication factor to be inserted for each graph, which is shown above the respective cursor.
Select Time Range:	Allows the selection of a time range that can be saved with "Save Time Range".
Show/Remove Legend:	A legend appears offering a number of modifications to the graph's appearance, e.g. its colors.